LETTERS TO THE EDITOR.

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The Leonids—a Forecast.

IN the *Proceedings* of the Royal Society for March 2, 1899 (vol. lxiv. p. 403), will be found an account of the perturbations suffered since 1866, November 13, by the Leonids which in that month intersected or passed close to the earth's orbit. This position in the meteor stream may be called station A (Fig. 1).

We have since investigated the principal perturbations affecting two other points in the stream, viz., the station *z*, which intersected the earth's orbit 360 days earlier, *i.e.* in November

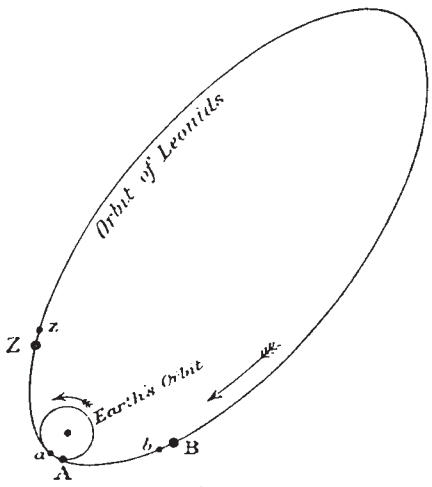

FIG. 1.

1865, and the station B, which intersected the earth's orbit 360 days later, *i.e.* in November 1867.

We therefore now know the principal perturbations which during the last revolution of the meteors have affected three points, *z*, A and B, situated along an orbit (Adams's orbit) which, at the commencement of the revolution, lay within the stream.

The full results of the investigation will not be ready for publication till after the time when the Leonid shower of this year is due, and on this account it has been thought expedient

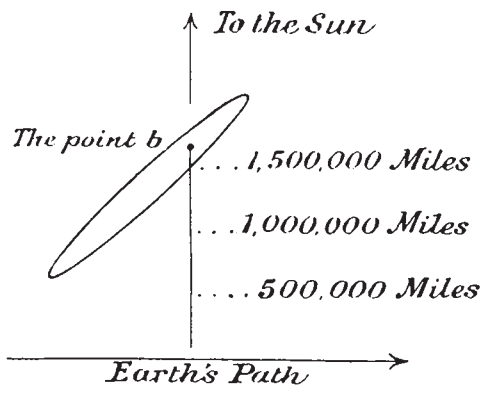

FIG. 2.

to publish beforehand such of the results as have special reference to it.

A point in the stream which in 1867 lay along Adams's orbit between A and B, but nearer B, and which we may call the point *b*, will this year reach its descending node simultaneously with the earth. This will happen approximately on 1900, November, 15d. 3h. Greenwich mean astronomical time.

Unfortunately, the orbit of a meteor situated near point *b* in the stream, instead of intersecting the earth's orbit as it did in 1867, will now pierce the plane of the ecliptic in a point which lies about 0·018 nearer the sun. Now, 0·018 of the earth's mean distance from the sun is 1,674,000 miles; so that, of the meteors which in 1867 intersected the earth's orbit, those which will come nearest to the earth in the present year will not approach it nearer than a million and six hundred thousand miles.

It is known from the duration of the great showers that the width of the ortho-stream, if measured in the direction which is parallel to the earth's path, is only about 300,000 miles; but there is reason to believe that the Leonids entered the solar system under conditions which have made the section of the stream much longer than it is broad, so that its trace upon the plane of the ecliptic is something like what is represented in Fig. 2. The longer axis of this cross section lay originally along the radius vector from the sun, but perturbations have acted on the Leonids for nearly 1800 years of such a kind as have probably caused the section of the stream to incline in the direction represented in the figure.

If the section is long enough to reach the earth's orbit, we shall have a great meteoric shower this year. It is, besides, just possible that a sinuosity in the stream may so displace a part of the section as to bring it sufficiently far out. But neither of these seem likely to have happened; so that the present investigation does not raise any hope of a great shower this year.

If, contrary to our expectation, the axis major of the section proves to be long enough to reach the earth's orbit, the consequent shower of ortho-Leonids is likely to occur several hours—possibly more than a whole day—earlier than

1900, November, 15d. 3h.

The number of hours by which it will precede that epoch depends upon the angle which the axis major of the section makes with the radius vector from the sun—an angle which is at present unknown. If there is this year a shower of ortho-Leonids, the time at which it occurs will enable us to determine this important datum.

Station *a* in the stream (see Fig. 1) intersected the earth's orbit in 1866, but after completing a revolution it passed the earth in November of last year at a distance of some 1,300,000 miles; and *z*, the corresponding point for the preceding year, which also intersected the earth's orbit in 1865, was on its return distant from the earth in November 1898 by about 960,000 miles. It thus appears that the displacements of the meteoric orbits which have been brought about by the perturbations of the last thirty-three years suffice to have prevented the meteoric orbit from now intersecting the earth's orbit. This accounts for our not having had any great shower in either of the last two years, and unfortunately the conditions seem still more unfavourable in the present year.

Nevertheless, as there is always a possibility that one or other of the contingencies mentioned above may carry a part of the ortho-stream out as far as the earth, and as we have no means of ascertaining whether those contingencies have arisen, it is desirable that preparation shall be made for adequately observing the shower, if it should unexpectedly come.

The perturbations during the last revolution, which have for the present carried the ortho-stream of Leonids so far from the earth's orbit, belong to the class of perturbations which act at different times with equal effect in opposite directions; so that there is reasonable ground for expecting that further perturbations must at some future time bring this remarkable stream back to the earth's orbit. It would be possible to ascertain when this will happen, by an investigation carried over a sufficient time forward upon the same lines as those which we have pursued.

G. JOHNSTONE STONEY.
A. M. W. DOWNING.

October 24.

Examinations in Experimental Science.

YOU occasionally do us, who are humble teachers of Elementary Science in schools, the very great kindness of giving us, through your columns, the chance of reaching the ears of those eminent men who are your frequent contributors, and who examine our pupils. Will you, in the interest of that real science teaching, so often advocated in your columns, allow me such a chance now? I will be as brief as possible. In common with a few individuals and many public bodies, I have spent a very large amount of time, money and labour in introducing the teaching of practical physics into my school, and trying to see that it shall be of the best kind possible, and I am prepared to do more.

But really there must be some agreement between us and the said eminent men as to what practical science is when the examination paper is composed.

May I give my illustration? The Cambridge Local Syndicate have introduced Elementary Experimental Science, three papers, into their junior syllabus. The other day I set two of these three papers for 1899 to a number of boys who had had a most careful experimental training in the matter of the syllabus. They made wry faces over it, and were heard to remark afterwards that they did not see what it had to do with the experiments they had been doing. On marking the papers I found that the best boys, really very good and careful experimenters and observers and good draughtsmen, for boys, barely reached forty per cent. of the marks. The same papers were set to a sharp boy of the same age who had done no experiments, but had been through the same subjects, mechanics, hydrostatics, and heat, in the old way, viz., text-book and problems. *He scored nearly full marks on all the physics questions.*

The fact is, that except for the heading, "Experimental Science," there is nothing in two of these papers to indicate that they are set to candidates whose knowledge is based on and drawn from experimental work of their own.

I should like to ask you to print these papers in full, that the eminent men who set them might have a chance of saying something, but on the whole I think your space is too valuable. I will simply quote two questions from the mechanics paper.

"(3) Explain how work is measured, and in what units.

"A 50 lb. shot is fired from a cannon with a velocity of 1500 feet per second. Compare the work done on the shot with that done by a man weighing 12 stone who walks up a hill 1500 feet high.

"(4) What is the mechanical advantage of a machine?

"How would you arrange three separate pulleys, each of which weighs 1 lb., so that the power required to raise a weight of 40 lbs. may be a minimum?

"What arrangement of pulleys is most commonly used in practice? And why?"

Now these are exactly the old Cambridge—"Describe the common pump, &c., questions?" and the way to answer them is to waste no time on experiments, but read your text-book, get up your formulæ and work examples. The second question is of exactly the same type. The other two require a graphical construction, but such as would be readily done by a boy who had used a text-book in which graphic methods were explained.

The first paper is almost equally bad; it is all (chemistry included) text-book science of a very common order. Against the practical paper I have nothing to say.

Now Cambridge men can write excellent elementary text-books on these subjects, witness those of Prof. Glazebrook. Can they not produce among them a paper on Elementary Experimental Science, which shall be what it professes to be, or is the tradition of the common pump still too strong, and the impress of the Mathematical Tripos too indelible?

A. H. F.

Literature of Coffee and Tobacco Planting.

IN the issue of NATURE of August 9 it is stated, in reviewing a book by a French author, that several books on the same subject, *i.e.* coffee—its growth, cultivation and preparation for the market—have already been published in English.

Could you kindly inform me of the names of the publishers or authors of any good works in English on coffee and tobacco growing? I have been, so far, quite unable, out here, to find the names of any publishers of works on tobacco or coffee, and as it is a matter of considerable moment to me to gain the best of information on these subjects, I trust you will see your way to help me.

Salisbury, Rhodesia, South Africa. G. H. JAMES.

[Mr. J. R. Jackson, Keeper of Museums at the Royal Gardens, Kew, to whom we referred our correspondent's inquiry, has kindly sent the following list of books, which may meet the requirements and also be of service to other planters. —Ed. NATURE.]

WORKS ON COFFEE AND TOBACCO PLANTING.

"The Coffee Planter of Ceylon," by William Sabonadière. Published by E. and F. N. Spon, 125, Strand. (1870.)

"Coffee Planting in Southern India and Ceylon," by E. C. P. Hull. E. and F. N. Spon. (1877.)

Article on coffee in "Spon's Encyclopædia of the Industrial Arts, Manufactures and Commercial Products." E. and F. N. Spon.

"Liberian Coffee in Ceylon." From the *Ceylon Observer*. Published at Colombo by A. M. and F. Ferguson. (1878.)

"All About Tobacco." Compiled by A. M. and F. Ferguson, Colombo, Ceylon. Agents, John Haddon and Co., Bouverie Street, London.

Article on tobacco in "Spon's Encyclopædia of the Industrial Arts, Manufactures and Commercial Products." E. and F. N. Spon.

Autotomic Curves.

IN NATURE, October 11, Mr. A. B. Basset justly inveighs against the use of the term "non-singular curve" to denote a curve which has no double points. Doubtless, also, the expression "an anautotomic curve" is objectionable.

May I suggest that, in this instance, we may obtain from Latin the help unknown to Greek, and designate curves which have, and curves which have not, double points, by the terms *sesecting* and *non-sesecting* respectively?

H. LANGHORNE ORCHARD.

44 Denning Road, Hampstead, N.W., October 20.

IN answer to your correspondent, Mr. A. B. Basset, would not the Anglo-Saxon negative prefix "un" combine more euphoniously with "autotomic" than the Greek "an"? We find analogy for such a combination in the familiar words "unauthorised" and "unauthenticated," where it is used in conjunction with words of Latin origin; so there seems no valid philological objection to its association with a Greek derivative, while the phrase "an unautotomic curve" would certainly sound more pleasantly to the ear than "an anautotomic" one.

ARTHUR S. THORN.

4, Malcolm Road, Penge, S.E., October 25.

THE PRESENT CONDITION OF THE INDIGO INDUSTRY.

OF late years attention has often been drawn to German Technical Chemistry, more especially in connection with the advance and growth of the coal-tar colour industry, an industry which received its birth in this country, but which has now taken up its abode on the continent, the loss of the industry to this country being largely due to the conservatism of our manufacturers, and also partly to the want of proper scientific training on the part of the few chemists whom the manufacturers have *deigned* to employ.[1]

Before 1870 the madder plant was very largely cultivated, in order to obtain from it the important dye-stuff alizarin. But in 1869 a process for obtaining alizarin, by fusing anthraquinone sulphonic acid with caustic soda, was patented simultaneously in this country and in Germany. As a consequence the madder plant is now hardly cultivated at all.[2] Now, thirty years later, another and perhaps even more important natural dye-stuff is in jeopardy owing to the advances of German science. The dye-stuff referred to is indigo, which is cultivated in such large quantities in our Indian Empire. If, then, the natural indigo is to be driven out of the market by the artificial substance, prepared from coal-tar products, it cannot fail to exert a great temporary, if not permanent, influence upon the wealth of India. Perhaps, then, a

[1] In the hand-book for the International Exhibition of 1862 (vol. i. p. 120), the following sentences occur: "It is impossible to overrate the importance of the coal-tar dyes to this country. From having the sources of the raw material in unlimited quantities under our very feet, we are enabled to compete most favourably with continental nations in this respect, and we shall soon become the great colour-exporting country, instead of having, as hitherto, to depend on Holland and other countries for our supply of dye-stuffs."

[2] Madder root contains about 1 per cent. of alizarin, and in 1859–1868 the best qualities of Turkey roots fetched 50*s*. per cwt.; this would make the price of alizarin about 45*s*. per lb. When artificial alizarin was first produced, the dry product fetched about 45*s*. to 50*s*. per lb. A 20 per cent. paste of alizarin is now sold for 7*d*. per lb.